



Soil Carbon Sequestration: Frequently Asked Questions

What is soil carbon sequestration?

Atmospheric concentrations of carbon dioxide can be lowered either by reducing emissions or by taking carbon dioxide out of the atmosphere and storing in it terrestrial, oceanic, or freshwater aquatic ecosystems. A sink is defined as a process or an activity that removes a greenhouse gas from the atmosphere. The long-term conversion of grassland and forestland to cropland (and grazing lands) has resulted in historic losses of soil carbon worldwide but there is a major potential for increasing soil carbon through restoration of degraded soils and widespread adoption of soil conservation practices.

What agricultural and forestry activities sequester carbon?

Forest and soil conservation practices not only reduce soil erosion but also increase the organic matter content of soils. Principal conservation strategies which sequester carbon include converting marginal lands to compatible land use systems, restoring degraded soils, and adopting best management practices. For example, removing agriculturally marginal land from production and adopting an ecologically compatible land use, such as wildlife habitat, can lead to increases in total biomass production and an increase in carbon content in the soil.

USDA programs such as the Conservation Reserve Program (CRP), the Wetland Reserve Program (WRP), the Stewardship Incentive Program (SIP), Forestry Incentives Program (FIP) and the Secretary's conservation buffer strip initiative all help increase soil organic carbon. Also important are various strategies for sustainable management of the soil, such as: (1) conservation tillage; (2) management of crop residue and application of organic materials and manures; (3) soil fertility optimization through site-specific management; (4) elimination of summer (bare) fallow; (5) use of winter cover crops and rotations; and (6) other techniques that may improve crop yields and reduce on-site and off-site production risks.

How much carbon could actually be sequestered through these activities?

The total carbon sequestration and fossil fuel offset potential of U.S. cropland is estimated 154 million metric tons of carbon per year or 133 percent of the total emissions of greenhouse gases by agricultural and forestry activities. While our lands can be managed to increase carbon storage, the increase can only temporarily offset greenhouse gas emissions. Many view land-based carbon sinks as buying valuable time to address the more significant challenge—reducing greenhouse gas emissions.

How accurately can we measure carbon sequestration in agricultural soils

Changes in soil carbon stocks are difficult to verify because of their temporal and spatial heterogeneity. The most direct means of determining soil carbon sequestration is to measure, over time, sequential changes in soil carbon. Such measurements are complicated by the slow rate of change. And soil carbon can exhibit significant field-scale variability due to varying topology management history. Ongoing studies to quantify the capacity for agricultural activities as carbon sinks are needed. Many researchers agree that we need to: strengthen the soil carbon database; obtain better data on soil processes that affect carbon; and increase our knowledge about the carbon effects of land conversion and soil management. There is a need to develop and standardize a methodology that will translate farm and forest systems in a landscape to carbon sequestration rates.

Is sequestering carbon compatible with other environmental goals important to agriculture?

Yes. USDA's conservation programs and many conservation practices available to and being used by landowners represent a multifaceted opportunity in light of climate change. Adoption of appropriate conservation strategies lead to: (1) carbon sequestration in soil; (2) improving soil quality by raising productivity and contributing to sustainable land use; and (3) enhancement of overall environmental quality through improved wildlife habitat, higher water quality and erosion reduction.

How are agricultural soil sinks treated in the Kyoto Protocol?

Agricultural sinks are acknowledged in the Kyoto Protocol, (particularly in Article 3.4) in a limited manner. International consensus has not been reached on the role of carbon sequestration in soils for the first reporting period under the Kyoto agreement. International activities that can help achieve consensus include workshops focusing on sequestration activities and an Intergovernmental Panel on Climate Change report currently underway on land use, land use change and forestry and the potential for greenhouse emission offsets. Keys to gaining international understanding of carbon sequestration include developing scientifically sound projections of the potential for sequestration from agricultural activities and developing agreed-upon methods for determining, reporting and verifying changes in soil carbon stocks.

What is USDA doing to better understand soil sequestration?

USDA research is focusing on understanding the role of agricultural ecosystems in the global carbon cycle. For example, scientists from USDA's Agricultural Research Service are using state-of-the-art technology to measure carbon dioxide emissions from soil during tillage and analyzing the rates of storage of atmospheric carbon dioxide as organic carbon in soils following the adoption of conservation practices. This research will help determine how much agricultural soils can serve as sinks for greenhouse gases. Scientists are also measuring the rates of carbon dioxide assimilation of rangelands to help climate modelers develop better estimates of future atmospheric carbon dioxide levels. USDA's Natural Resources Conservation Service (NRCS) is focusing on improving the Nation's soil carbon database. This information is necessary to show how much carbon has been lost and the potential for future sequestration. NRCS also is developing models to link on farm practices to carbon sequestration and to assess regional and national carbon sequestration rates. The Forest Service is developing management practices to increase sequestration and are implementing such practices on the national forests.